SURVEY FOR CONTAMINANTS IN SEDIMENTS AND FISH AT SELECTED SITES ON THE ILLINOIS RIVER AND TRIBUTARIES

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ABSTRACT

A basin-wide survey of contaminants in sediments and biota at several locations on the Illinois River and selected tributaries was conducted during the 1989 field season. The study area along the Illinois River extended from the Chicago, Illinois area, down river to the Grafton, Illinois area. Bottom sediments and fish were collected at pre-designated sampling locations. Chemical analysis, aquatic bioassays, and Microtox assays were performed on samples from each location. The results indicate that there are several critical areas of concern throughout the upper and mid-portions of the Illinois River.

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SURVEY FOR CONTAMINANTS AT SELECTED SITES ON THE ILLINOIS RIVER AND TRIBUTARIES

Introduction

This study was designed to identify potential contaminants originating from several critical point sources along the Illinois River. Primary suspected sources of contaminants to the river ecosystem include sewage outfalls and industrial outfalls in major metropolitan areas. The potential for adverse impacts to national wildlife refuge (NWR) lands such as Chautauqua NWR and the Brussels District of the Mark Twain NWR is significant, considering the history of pollution in the Illinois River waterway.

Baseline data has been developed on organic and inorganic contaminants in sediments and fish, and acute toxicity from Chicago, Illinois downstream to the Mark Twain NWR near Grafton, Illinois. Specific sampling sites were designated within this general area. Sediment samples collected at each site were partitioned into subsamples upon which a battery of analytical tests were performed: bulk sediment chemical analysis of a range of organic and inorganic parameters, 96-hour larval fathead minnow bioassays, and Microtox analyses. This paper reports the concentrations of organic and inorganic chemicals in common carp and bed sediments, the results of fathead minnow bioassays, and the results of the Microtox assays for sediment samples at selected locations throughout the Illinois River basin.

Study Area

The study area encompasses the Illinois River and tributaries, from Chicago, Illinois downstream to the Mark Twain NWR near Grafton, Illinois. The primary tributaries included in this study were the North Branch of the Chicago River, the North Shore Channel, the Chicago River, the South Branch of the Chicago River, the Des Plaines River, the DuPage River, the Kankakee River, the Calumet Sag Channel, the Little Calumet River, the Grand Calumet River, the Chicago Sanitary and Ship Canal, and the Fox River. The sampling locations are shown in Figure 1.

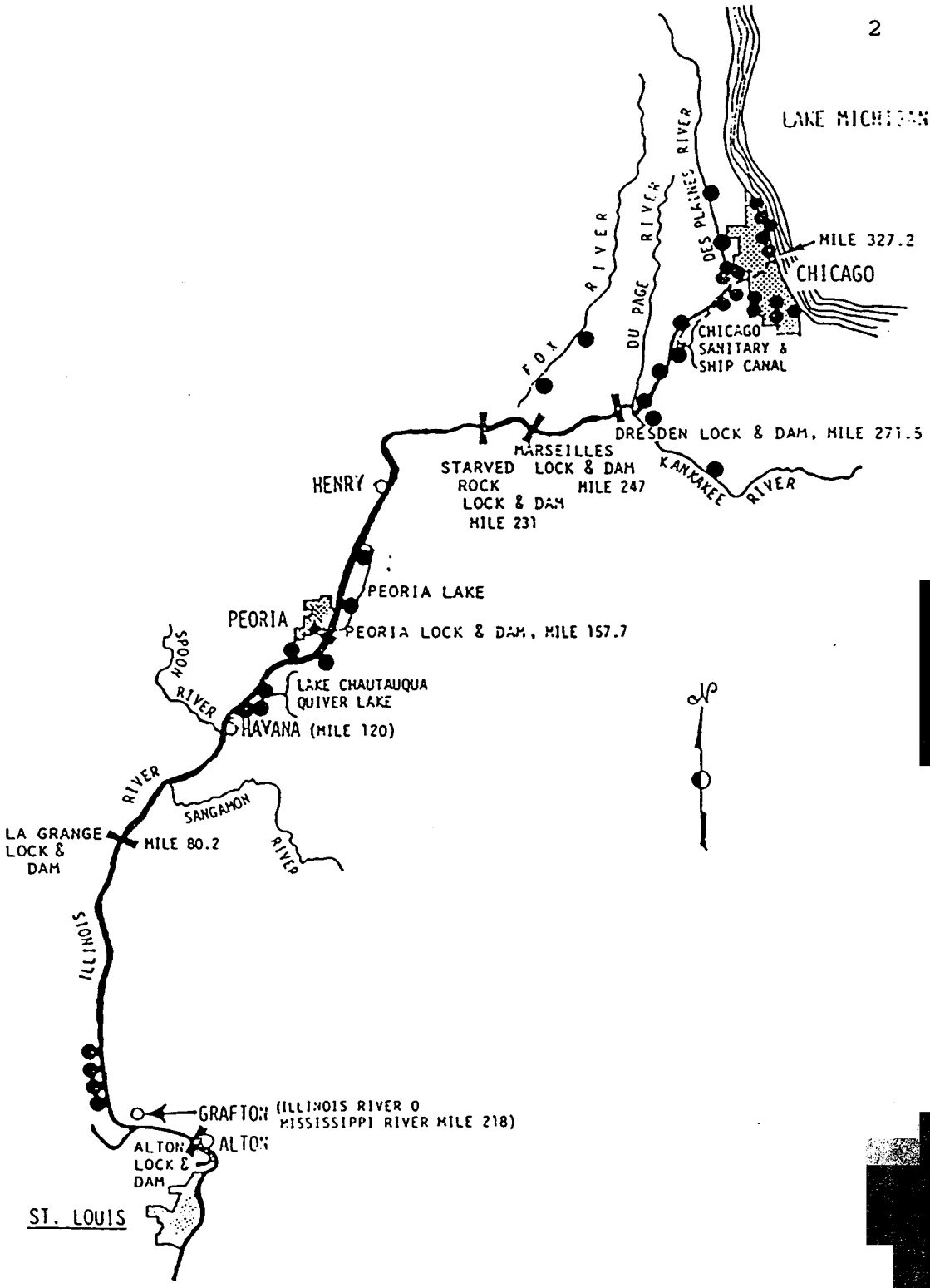

Figure 1. SAMPLING LOCATIONS ON THE ILLINOIS RIVER IN 1989

Methodology

Sample Collections

Bottom sediment samples were collected at 32 sampling locations (Table 1), and fish were collected at 14 sampling locations (Table 2) on the Illinois River and selected tributaries. Twelve sites were located on national wildlife refuge lands and twenty sites were located primarily adjacent to industrial areas.

One composite bottom sediment sample, comprised of three to five subsamples, was collected at each site. Sediments were collected primarily with a ponar dredge sampler. At a few of the sites where extremely shallow water conditions prevailed, sediment samples were collected by hand with a stainless steel spoon and holding container. The subsamples were placed in acetone-rinsed stainless steel containers and thoroughly mixed, then proportioned into 500 ml acid-cleaned jars with teflon-lined lids. The sampling equipment was rinsed with acetone between each sample site location. The sample containers were labeled and stored at ambient temperature in the field, then later shipped frozen to the analytical facility.

Carp were selected as a representative fish species since they are a ubiquitous bottom feeder. The fish were collected using an electroshocking boat. Two composite samples, one with 3 to 5 small (<1 lb), fish and the other with 3 to 5 large (>5 lb) fish, were sampled at each location. Measurements of weight and total length were taken. The fish were then double wrapped in aluminum foil, stored on ice in the field, and then frozen upon returning. Whole body analyses were performed for cadmium, chromium, copper, lead, and an organochlorine pesticide screen including arochlor specific PCBs.

Chemical Analysis

Chemical residue analysis for the organic compounds was performed by Geochemical and Environmental Research Group at Texas A&M University, College Station, Texas. Sediment samples were analyzed for organochlorine compounds, specifically total chlordane, and total and arochlor specific PCB's, and polycyclic aromatic hydrocarbons. The sediment samples were extracted using the soxhlet extraction method. Freeze-dried samples were homogenized, and a small portion of the sample was weighed into the extraction apparatus and extracted for 12 hours. The organochlorine fraction was isolated by purification of the extracts by silica/aluminum chromatography. The extracts were then analyzed by gas chromatography. The limit of quantification was 0.50 ppm.

Table 1. ILLINOIS RIVER 1989 SURVEY SAMPLING SITES - BOTTOM SEDIMENTS (bulk chemistry and bioassay).

Sample Location	# Samples Collected	Sample Number	River Mile
North Shore Channel	2	1 2	
North Branch, Chicago River	1	3	326.4
Chicago River (downtown Chicago)	1	4	326.2
South Branch, Chicago River	1	5	326.0
Little Calumet River (at Grand Calumet)	1	6	
Calumet River (at Grand Calumet)	1	7	327.5
Grand Calumet River	1	8	327.5
Little Calumet River (Calumet sewage treatment plant vicinity)	2	9 10	322-320.4
Calumet Sag Channel	2	11 12	316-305.0
Chicago Sanitary and Ship Canal	4	13 14 15 16	317.2 313.2 305.0 293.2
Kankakee River	2	17 18	
Des Plaines River	3	19 20 21	 286.0
Fox River	2	22 23	
Illinois River/ Treats Island	1	24	279.8

Table 1 continued. ILLINOIS RIVER 1989 SURVEY SAMPLING SITES - BOTTOM SEDIMENTS (bulk chemistry and bioassay).

Sample Location	# Samples Collected	Sample Number	River Mile
Illinois River/ Channahon	1	25	278.0
Peoria Lake	2	26	175.0
		27	176.0
Illinois River/ Mapleton	1	28	
Illinois River/ Kingston Mines	1	29	138.8
Chautauqua NWR	3	30	(127-122)
		31	
		32	
Mark Twain NWR Brussels District (Swan Lake)	4	33	(12-5)
		34	
		35	
		36	

Table 2. ILLINOIS RIVER 1989 SURVEY SAMPLING SITES - FISH

Sample Location	# Samples Collected	Sample Number	River Mile
Chicago River (downtown Chicago)	1 composite (5)	4	326.2
Little Calumet River (Riverdale, Illinois)	1 composite (3)	10	320.6
Kankakee River	1 composite (5)	18	---
Des Plaines River (Lyons, IL)	1 composite (5)	20	---
Des Plaines River (Joliet, IL)	1 composite (5)	21	(286.0)
Fox River (Yorkville, IL)	1 composite (5)	22	---
Illinois River (Treats Island)	1 composite (5)	24	279.8
Peoria Lake (Detweillers Marina)	1 composite (5)	26	175.0
Peoria Lake (Chilcothe, IL)	1 composite (5)	27	176.0
Chautauqua NWR	1 composite (5)	30	(127-122.0)
Chautauqua NWR	1 composite (5)	32	(127-122.0)
Mark Twain NWR Brussels District (Swan Lake)	1 composite (5)	33	(12-5.0)

Chemical residue analysis for the inorganic compounds was performed by Environmental Trace Substances Research Center, Columbia, Missouri. Sediment samples were analyzed for approximately 18 metals, using inductively coupled plasma (ICP) analysis. Arsenic, mercury, and selenium concentration determinations were made using atomic absorption spectroscopy.

Toxicity Tests

Bioassays were performed on sediment samples by the University of Iowa - Hygienics Laboratory in Des Moines, Iowa. 96-hour larval fathead minnow bioassays were conducted on sub-samples from each site. The standard U.S. Environmental Protection Agency larval fathead minnow technique was employed. One part sediment was mixed with three parts water and allowed to settle for 24 to 48 hours. The pH and oxygen in the test solution were adjusted prior to introduction of test organisms. Twenty to 25 organisms were exposed to the test containers. Dead organisms were removed from the test containers at 24-hour intervals, and their numbers were recorded. A water sample was taken prior to introduction of the test organisms and analyzed for the following parameters: total ammonia, nitrate nitrogen, nitrite nitrogen, organic nitrogen, pH and temperature. The percentage un-ionized ammonia concentrations were calculated from these data.

Results and Discussion

Sediment - Inorganics

The composited sediment samples were analyzed individually for eight inorganic parameters. The results of the chemical analyses for the inorganic elements in sediment samples are presented in Appendix A, Table A-1. The concentrations of many of the inorganics did not vary significantly in the reported values of mg/kg dry weight. However, concentrations of selected inorganics showed a wide range at several sampling locations on the Illinois River and its tributaries. These inorganics were arsenic, which ranged from 1.5 mg/kg on the Fox River, to 16.5 mg/kg on the Calumet River; cadmium, which ranged from 0.24 mg/kg on the Mark Twain NWR (Swan Lake), to 32.2 mg/kg on the Chicago Sanitary & Ship Canal; chromium, which ranged from 9.8 mg/kg on the Fox River, to 289.0 mg/kg in the Des Plaines River; lead, which ranged from 13.0 mg/kg on the Fox River, to 535.0 mg/kg in the Chicago River (downtown Chicago); mercury, which ranged from <0.02 mg/kg on the Fox River, to 2.78 mg/kg in the Des Plaines River; nickel, which ranged from 6.8 mg/kg on the Fox River, to 140.0 mg/kg on the Chicago Sanitary & Ship Canal; and selenium, which ranged from 0.2 mg/kg on the Mark Twain NWR (Swan Lake), to 2.6 mg/kg on the Little Calumet River.

Background concentrations of each of these elements might reasonably be expected to represent the minimum concentrations detected for each element, since many of these minimum concentrations were detected at non-industrial locations. These sites were not suspected to be contaminated. Thus, several sites have inorganic contaminants significantly elevated above background, and represent areas of potential concern due to those elevated concentrations detected.

Sediment - Organics

Each composited sediment sample was also analyzed for twenty-five organochlorine compounds. The results of the chemical analyses for the organochlorine compounds in sediment samples are presented in Appendix A, A-2. Many of the sampling locations did not exhibit significant organochlorine contamination in sediments. Only four sites indicated any organochlorine contaminants present in sediments at all. One site was on the North Shore Channel of the Chicago River, which indicated contamination by DDE, DDD, and DDT, where p,p'DDE was detected at 0.30 mg/kg, p,p'DDD was detected at 0.70 mg/kg, and p,p'DDT was detected at 0.14 mg/kg. On the Chicago Sanitary & Ship Canal, Arochlor 1248 was detected at 6.9 mg/kg, Arochlor 1254 was detected at 2.0 mg/kg, and Arochlor 1260 was detected at 4.0 mg/kg. On the Chicago River, chlordane (total) was detected at 0.20 mg/kg.

Because organochlorine pesticides are man-made compounds, a typically clean environment should contain no detectable concentrations. However, for the few sites that did show some contamination by organochlorines, the concentrations detected were not indicative of a significant sediment contamination problem.

Each composited sediment sample was also analyzed for fourteen polynuclear aromatic hydrocarbon compounds (PAH's) and oil and grease. The results of the chemical analyses for the polynuclear aromatic hydrocarbons compounds are presented in Appendix A, A-3. The concentrations of many of the PAH's at several of the sampling sites did vary significantly for the sediment samples collected on the Illinois River. These particular compounds were phenanthrene, which ranged from non-detectable at several sites, to 13.22 mg/kg on the Chicago Sanitary & Ship Canal; fluoranthrene, which ranged from non-detectable at several sites, to 11.08 mg/kg on the Des Plaines River; pyrene, which ranged from non-detectable at several sites to 8.13 mg/kg on the Chicago Sanitary & Ship Canal; 1,2 benzanthracene, which ranged from non-detectable at several sampling locations, to 5.15 mg/kg on the Des Plaines River; chrysene, which ranged from non-detectable at several locations, to 6.70 mg/kg on the Des Plaines River; benzo(b)fluoranthrene, which ranged from non-detectable at several locations, to 4.67 mg/kg at Channahon, Illinois;

benzo(k)fluoranthrene, which ranged from non-detectable at several sampling locations to 2.44 mg/kg on the Des Plaines River; benzo(e)pyrene, which ranged from non-detectable at several sampling locations to 4.12 mg/kg on the Des Plaines River; benzo(a)pyrene, which ranged from non-detectable at several locations, to 6.44 mg/kg on the Des Plaines River; and benzo (g,h,i) perylene, which ranged from non-detectable at several locations, to 3.09 mg/kg on the Des Plaines River. Oil and grease concentrations ranged from 145 on the Mark Twain NWR (Swan Lake), to 74108 on the Chicago Sanitary & Ship Canal.

Because PAH's are considered to be naturally occurring compounds, as well as occurring in the environment due to anthropogenic sources, there may be some minimal background concentrations present. However, several locations, particularly non-industrialized locations (with a few exceptions) did not exhibit any detectable concentrations of PAH's during the present study. Therefore, background concentrations of PAH's in the Illinois River study area may be considered below detection. PAH's may be contaminants of concern at those areas of elevated concentrations identified above.

Fish

Carp were collected at eight sampling locations on the Illinois River, and composited fish tissue samples were analyzed for seven inorganic parameters. The results of the chemical analyses for the inorganics in fish samples are presented in Appendix B, Table B-1.

The fish samples collected at each of the eight sampling locations described above were also analyzed for twenty-five organochlorine compounds. The results of the chemical analysis for the organochlorine compounds are presented in Table B-2.

Bioassays

Acute sediment exposure bioassays were conducted with composited sediment samples with larval fathead minnows, using a solid phase sediment and water beaker test technique. The results of the 96-hour fathead minnow bioassays are presented in Table 3. Water quality parameters were measured for bioassays conducted for each sediment sample. The water quality parameters measured are presented in Appendix C, Table C-1. Ammonia may be a factor in some of the acute mortalities.

Limitations

There are some additional considerations with regards to sample collection and handling procedures that need to be acknowledged. First of all, although composited samples were collected at each sampling location, the area in which the subsamples were

Table 3. 1989 Illinois River solid phase sediment and water 96-hour fathead minnow bioassay results (total mortality at 96-hours of exposure).

Sample Location	River Miles(s)	Sample Number	Fathead minnow mortality (number dead/number tested): Control	Sample
North Shore Channel				
		1/IR-1	0/20	2/20
		2/IR-2	2/20	21/21
North Branch, Chicago River				
	326.4	3/IR-3	0/21	20/20
Chicago River (downtown Chicago)				
	326.2	4/IR-4	2/20	15/20
South Branch, Chicago River				
	326.0	5/IR-5	0/21	0/20
Little Calumet River (at Grand Calumet)				
	327.0	6/IR-6	0/21	0/20
Calumet River (at Grand Calumet)				
		7/IR-7	0/21	18/20
Grand Calumet River (at Calumet River)				
	327.5	8/IR-8	0/21	5/20
Little Calumet River (Calumet Sewage treatment plant vicinity)				
	322.0	9/IR-9	0/21	20/20
	320.6	10/IR-10	0/20	20/20
Calumet Sag Channel				
	316.0	11/IR-11	0/20	20/20
	305.0	12/IR-12	0/21	20/20
Chicago Sanitary and Ship Canal				
	317.2	13/IR-13	1/20	20/20
	313.2	14/IR-14	0/21	20/20
	305.0	15/IR-15	0/20	20/20
	293.2	16/IR-16	0/21	20/20
Kankakee River				
		17/IR-17	0/20	12/20
		18	1/20	4/20
Des Plaines River				
		19	0/21	1/21
		20/IR-20	0/21	0/20
	286.0	21/IR-21	0/20	20/20
Fox River				
		22/IR-22	0/20	20/20
		23/IR-23	0/21	20/20

Table 3 continued. 1989 Illinois River solid phase sediment and water 96-hour fathead minnow bioassay results (total mortality at 96-hours of exposure).

Sample Location	River Miles(s)	Sample Number	Fathead minnow mortality (number dead/number tested): Control	Sample
Illinois River/ Treats Island	279.8	24/IR-24	0/20	17/20
Illinois River/ Channahon	278.0	25/IR-25	0/21	20/20
Peoria Lake	175.0	26/IR-33	0/20	1/21
	176.0	27/IR-26	0/21	1/20
Illinois River/ Mapleton		28/IR-27	0/20	1/20
Illinois River/ Kingston Mines	152.5	29/IR-28	0/21	0/20
Chautauqua NWR	127-122	30/IR-29	0/20	0/20
		31/EMP-29	0/20	0/20
		32/IR-30	0/20	0/20
Mark Twain NWR Brussels District Swan Lake	12-5	33/IR-31A	0/20	0/20
		34/IR-31B	0/20	0/20
		35/IR-32	0/20	0/20
		36/IR-34	0/20	0/20

in most cases did not exceed 30 feet in diameter. Therefore, any significantly widespread areas of bed sediment contamination cannot be predicted from these data. Secondly, with regards to sample handling, recent studies indicate that freezing sediment samples may alter the form of some chemical compounds, particularly polynuclear aromatic hydrocarbons, and some organochlorine compounds. This alteration due to freezing (and subsequent thawing) may have the effect of depressing contaminant concentrations actually measured in a sediment sample. Thus, the concentrations listed above in the preceding tables may actually underestimate concentrations of certain contaminants at many of the sampling sites in the present study. Another potential concern is the sample holding time for the samples collected in the present study prior to extraction for analysis. Most samples were held frozen for approximately 6 months, prior to extraction and analysis. Such a lengthy time is generally acceptable for inorganics, but unacceptable for organics.

Summary

Baseline data on inorganic and organic contaminants was developed during the present study. The sediment and water exposure bioassays characterized certain sampling locations as being acutely toxic to aquatic organisms (Table 4). At the specific sampling locations where sediment contaminants were elevated above background, or sediments were toxic to fathead minnows, there is a potential for acute (and chronic) toxicity of sediments to other aquatic organisms, as well as bioaccumulation to other aquatic species, for those particular contaminants known to have the potential to bioaccumulate.

It is recommended that additional studies be considered in several areas in the Illinois River basin to further define the sediment contamination problems suggested by elevated contaminants and/or significant toxicity to aquatic species.

Table 4. A summary of locations on the Illinois River Waterway where sediment toxicity resulted in 50% or greater larval fathead minnow mortality in a 96-hour bioassay (from Table 3).

River Mile	Location
	North Shore Channel
326.4	North Branch, Chicago River
326.2	Chicago River
	Calumet River
322.0 320.6	Little Calumet River
316.0 305.0	Calumet Sag Channel
317.2 293.2	Chicago Sanitary and Ship Canal
	Kankakee River
286.0	Des Plaines River
	Fox River
279.8	Illinois River/Treats Island
278.0	Illinois River/Channahon

Bibliography

Anderson, R.V. 1977. Concentration of cadmium, copper, lead, and zinc in six species of freshwater clams. Bulletin of Environmental Contamination and Toxicology 18-4: 492-496.

Blodgett, K.D., R.E. Sparks, A.A. Papero, R.A. Cahill and R.V. Anderson. 1984. Distribution of toxicity in the sediments of the Illinois waterway. In, Urban Effects on Water Quality and Quantity, edited by W. Blake-Coleman. Conference Proceedings of Oct. 20-21, 1983 at Jumer's Castle Lodge, Urbana, Ill., pages 293-308.

Chapman, P.M. 1986. Sediment quality criteria from the sediment quality tried: an example. Environ., Toxicol. Chem. 5:965-976.

Chapman, P.M. 1989. Current Approaches to Developing Sediment Quality Criteria. Environ., Toxicol. Chem., 8:589-599.

Field, L.J. and R.N. Dexter. 1988. A discussion of PCB target levels in aquatic sediments. Unpublished report by NOAA, Seattle, Washington.

Goalsky, D.A. and E.M. Thurman. 1990. Herbicides in rivers and streams of the midwestern United States pages in, Proceedings of the 46th Annual Meeting of the Upper Mississippi River Conservation Committee (draft in progress).

Grettenberger, J.F. and R. Ruelle. 1990. A preliminary contaminant and toxicological survey of Illinois River sediments. Draft report prepared by the U.S. Fish and Wildlife Service, Rock Island Field Office, Rock Island, Illinois. 16pp.

Harper, S.W., C.A. Pettigrew and G.A. Saylor. 1990. Ecological effects and prospects for the dimineation of environmental polychlorinated biphenyls (PCB's). Environ. Toxicol. Chem. 9:655-66.

Illinois Environmental Protection Agency. 1990. Illinois Water Quality Report, 1988, 1989. IEPA/WPC/90-160. 324pp.

Kelly, M.H. and R.L. Hite. 1984. Evaluation of Illinois Stream Sediment Data: 1974-1980. IEPA/WPC/84-004. Illinois Environmental Protection Agency. 105pp.

Loe, T.P., May, T.W., Brumbaugh, W.G., Kane, D.A. 1985. National Contaminant Biomonitoring Program. Concentrations of seven elements in freshwater fish, 1978-1981. Arch. Environ. Contam. Toxicol. 14:363-388.

Lymen, W.J., A.E. Gleyer, J.H. Onaz and S. Coons. 1987. An Overview of Sediment Quality in the United States. EPA-905/9-88-002. 112pp.

Mathis, B.J. and T.F. Cummings. 1973. Selected metals in sediments, water, and biota in the Illinois River. Journal of the Water Pollution Control Federation Vol. 45 (7):1573-1583.

May, T.V., McKinney, G.L. 1981. Cadmium, mercury, arsenic, and selenium concentrations in freshwater fish, 1976-1977-National Pesticide Monitoring Program. Pest. Monit. J. 15:14-38.

Murchelane, R.A. 1988. Fish as Sentinels of Environmental Health. National Oceanic and Atmospheric Administration Technical Memorandum NMFS-F/NEC-61. U.S. Dept. of Commerce. 16pp.

Nades, D.M. 1987. Surface Water Quality Assessment of the Upper Illinois River Basin in Illinois, Indiana, and Wisconsin: Project Description. U.S. Geological Survey Open File Report 87-473. 35pp.

National Oceanic and Atmospheric Administration. 1990. The Potential for Biological Effects of Sediment. Sorbed Contaminants Tested in the National Status and Trends Program. NOAA Technical Memorandum NOS OMA 52. 175pp.

Persaud, D.R. Jaqaumagi and A. Heyton. 1989. Development of Provincial Sediment Quality guidelines. Draft report prepared by the Ontario Ministry of the Environment, Water Resources Branch, Aquatic Biology Section.

Ruelle, R. and J. Kennedy. 1988. Does Effluent Monitoring Adequately Protect Receiving Waters and Sediments. Draft report prepared by the U.S. Fish and Wildlife Service, Rock Island, Illinois and the University of Iowa Hygienic Laboratory, Des Moines, Iowa. 25pp.

Schmitt, C.J., J.L. Zajicek and P.H. Peterman. 1990. National Contaminant Biomonitoring Program: Residues of Organochlorine Chemicals in U.S. Freshwater Fish, 1976-1984. Arch. Environ. Contam. Toxicology, 19:748-781.

Schmitt, C.J., Ribick, M.A., Ludke, May, T.W. 1983. Organochlorine residues in freshwater fish, 1976-1979: National Pesticide Monitoring Program. U.S. Fish and Wildlife Service, Washington, D.C., Resource Pub. 152. 62pp.

Schmitt, C.J. and W.G. Brumbaugh. 1990. National Contaminant Biomonitoring Program: Concentrations of arsenic, cadmium, copper, lead, mercury, selenium, and zinc in U.S. Freshwater Fish, 1976-1984. Arch. Environ. Contam. Toxicol. 19:731-747.

Schmitt, C.J., Jzeyckek, J.L. and Rubick, M.A. 1985. National Pesticide Monitoring Program: Residues of organochlorine chemicals in freshwater fish 1980-1981. Arch. Environ. Contam. Toxicol. 14:225-260.

Schmitt, C.J., Ludke, J.L. and Walsh, D. 1981. Organochlorine residues in fish, 1970-1974: National Pesticide Monitoring Program. Pestic. Monit. J. 14:136-206.

Sparks, R.E. 1984. The role of contaminants in the decline of the Illinois River: Implications for the Upper Mississippi. pages 25-67 in, Contaminants in the Upper Mississippi River, edited by J.G. Wiener, R.V. Anderson, and D.R. McConville. Butterworth Publishers, 368pp.

Thurston, R.V., R.C. Russo and G.R. Phillips. 1983. Acute toxicity of ammonia to fathead minnows. Trans. Amer. Fish. Sec. 112:705-711.

Thurston, R.V., R.C. Russo, and E.L. Meyer. 1986. Chronic toxicity of ammonia to fathead minnows. Trans. Amer. Fish. Sec. 115:196-207.

U.S. Environmental Protection Agency. 1987. The National Dioxin Study: Tiers 3, 5, 6, and 7: (EPA 440/4-87-003) Office of Water Regulations and Standards, Washington, D.C. 73pp.

APPENDIX A

SEDIMENT DATA

Table A-1. Concentrations (mg/kg dry weight) of inorganic elements detected in sediments collected from the Illinois River 1989.

Sample Location	River Mile(s)	Sample Number	Sample Weight	Percent Moisture	As	Cd	Cr	Cu	Pb	Hg	Ni	Se
North Shore Channel		1/IR-1	823.1	51.4	5.9	2.0	44.0	128.0	150.0	0.88	26.0	0.91
		2/IR-2	858.7	32.7	3.5	6.4	74.0	79.8	130.0	0.39	55.0	0.60
North Branch, Chicago River	326.4	3/IR-3	482.7	53.8	7.3	3.0	17.0	19.0	28.0	1.6	10.0	1.9
Chicago River (downtown Chicago)	326.2	4/IR-4	839.4	46.7	8.7	7.0	92.0	182.0	535.0	2.14	39.0	0.82
South Branch, Chicago River	326.0	5/IR-5	750.0	60.9	6.7	28.8	218.0	414.0	519.0	1.9	135.0	1.5
Little Calumet River (at Grand Calumet)	327.0	6/IR-6	No data collected									
Calumet River (at Grand Calumet)		7/IR-7	776.4	51.2	16.5	1.4	42.0	59.6	120.0	0.15	38.0	0.64
Grand Calumet River (at Calumet River)	327.5	8/IR-8	795.6	44.3	14.6	1.8	45.0	63.6	160.0	0.17	36.0	0.74
Little Calumet River (Calumet Sewage treatment plant vicinity)	322.0	9/IR-9	741.6	47.6	9.4	3.0	61.0	111.0	250.0	1.2	34.0	1.1
	320.6	10/IR-10	767.4	62.5	10.8	11.0	119.0	151.0	280.0	1.3	42.0	2.6
Calumet Sag Channel	316.0	11/IR-11	885.2	34.7	11.9	4.0	50.0	73.7	210.0	0.75	28.0	0.8
	305.0	12/IR-12	919.1	38.6	7.8	6.6	100.0	87.0	220.0	0.54	28.0	1.3
Chicago Sanitary and Ship Canal	317.2	13/IR-13	806.9	41.9	7.7	16.0	228.0	308.0	360.0	1.4	140.0	0.90
	313.2	14/IR-14	689.4	50.5	6.3	18.0	185.0	207.0	210.0	0.60	137.0	0.98
	305.0	15/IR-15	606.5	47.4	7.2	32.2	281.0	269.0	280.0	0.77	130.0	1.2
	293.2	16/IR-16	699.7	43.9	5.9	18.0	155.0	142.0	140.0	0.56	50.0	0.88
Kankakee River		17/IR-17	831.9	52.9	5.5	0.42	14.0	14.0	21.0	0.04	13.0	0.58
		18										
Des Plaines River		19										
		20/IR-20	1018.4	38.2	3.2	1.5	33.0	53.5	82.0	0.18	18.0	0.3
	286.0	21/IR-21	758.9	60.9	10.9	27.9	289.0	286.0	310.0	2.78	120.0	1.7

Table A-1, continued. Concentrations (mg/kg dry weight) of inorganic elements detected in sediments collected from the Illinois River 1989.

Sample Location	River Mile(s)	Sample Number	Sample Weight	Percent Moisture	As	Cd	Cr	Cu	Pb	Hg	Ni	Se
Fox River		22/IR-22	683.1	59.6	3.6	1.9	28.0	46.8	52.0	0.14	19.0	0.58
		23/IR-23	795.4	41.0	1.5	0.41	9.8	9.6	13.0	<0.02	6.8	0.2
Illinois River/ Treats Island		24/IR-24	644.9	39.6	11.0	16.0	161.0	162.0	220.0	2.0	79.0	1.1
Illinois River/ Channahon	278.0	25/IR-25	670.5	55.2	5.9	8.9	110.0	110.0	140.0	0.66	61.0	1.0
Peoria Lake	175.0	26/IR-33	1069.4	29.5	3.5	1.1	21.0	18.0	18.0	0.21	18.0	0.3
	176.0	27/IR-26	807.5	53.4	6.4	3.6	56.0	54.0	55.0	0.32	48.0	0.59
Illinois River/ Mapleton		28/IR-27										
Illinois River/ Kingston Mines	152.5	29/IR-28	905.6	44.0	4.1	1.1	28.0	23.0	23.0	0.11	24.0	0.4
Chautauqua NWR	127-122	30/IR-29	826.6	57.2	4.7	0.94	31.0	23.0	25.0	0.099	29.0	0.78
		31/EMP-29	986.1	46.6	3.4	0.53	25.0	19.0	19.0	0.081	25.0	0.35
		32/IR-30	950.5	48.6	3.9	0.29	12.0	10.0	17.0	0.05	13.0	0.70
Mark Twain NWR Brussels District Swan Lake	12-5	33/IR-31A	912.2	41.5	3.9	0.49	27.0	17.0	28.0	0.06	21.0	0.3
		34/IR-31B	930.8	48.6	5.8	0.57	30.0	26.0	20.0	0.084	32.0	0.52
		35/IR-32	614.4	12.4	4.9	0.41	24.0	17.0	22.0	0.06	22.0	0.34
		36/IR-34	617.7	12.7	5.2	0.24	22.0	14.0	49.0	0.05	16.0	0.2

Table A-2. Concentrations (mg/kg dry weight) of organochlorine compounds detected in sediments collected from the Illinois River in 1989.

Sample Location	River Mile(s)	Sample Number	Sample Wt.	%Moisture	HCB	Alpha BHC	Beta BHC	Gamma BHC	Delta BHC	Heptachlor Epoxide
North Shore Channel										
		1/IR-1	650.0	50.4	ND	ND	ND	ND	ND	ND
		2/IR-2	827.0	38.6	ND	ND	ND	ND	ND	ND
North Branch, Chicago River										
	326.4	3/IR-3	543.0	53.0	ND	ND	ND	ND	ND	ND
Chicago River (downtown Chicago)										
	326.2	4/IR-4	604.0	43.2	ND	ND	ND	ND	ND	ND
South Branch, Chicago River										
	326.0	5/IR-5	572.0	59.8	ND	ND	ND	ND	ND	ND
Little Calumet River (at Grand Calumet)										
	327.0	[illegible] collected								
Calumet River (at Grand Calumet)										
		7/IR-7	764.0	56.0	ND	ND	ND	ND	ND	ND
Grand Calumet River (at Calumet River)										
	327.5	8/IR-8	780.0	46.2	ND	ND	ND	ND	ND	ND
Little Calumet River (Calumet Sewage treatment plant vicinity)										
	322.0	9/IR-9	700.0	53.2	ND	ND	ND	ND	ND	ND
	320.6	10/IR-10	749.0	65.0	ND	ND	ND	ND	ND	ND
Calumet Sag Channel										
	316.0	11/IR-11	902.0	33.8	ND	ND	ND	ND	ND	ND
	305.0	12/IR-12	916.0	41.0	ND	ND	ND	ND	ND	ND

Table A-2, continued. Concentrations (mg/kg dry weight) of organochlorine compounds detected in sediments collected from the Illinois River in 1989.

Sample Location	River Mile(s)	Sample Number	Oxy-chlordane	Alpha-chlordane	Gamma chlordane	Cis-Nonachlor	Trans-Nonachlor	Dieldrin	Endrin	Mirex
North Shore Channel										
		1/IR-1	ND	ND	ND	ND	ND	ND	ND	ND
		2/IR-2	ND	ND	ND	ND	ND	ND	ND	ND
North Branch, Chicago River	326.4	3/IR-3	ND	0.05	0.05	ND	0.04	ND	ND	ND
Chicago River (downtown Chicago)	326.2	4/IR-4	ND	0.02	0.01	ND	0.02	ND	ND	ND
South Branch, Chicago River	326.0	5/IR-5	ND	0.02	0.03	ND	0.02	ND	ND	ND
Little Calumet River (at Grand Calumet)	327.0	6/	No data collected							
Calumet River (at Grand Calumet)		7/IR-7	ND	ND	ND	ND	ND	ND	ND	ND
Grand Calumet River (at Calumet River)	327.5	8/IR-8	ND	ND	ND	ND	ND	ND	ND	ND
Little Calumet River (Calumet Sewage treatment plant vicinity)	322.0	9/IR-9	ND	ND	ND	ND	ND	ND	ND	ND
	320.6	10/IR-10	ND	ND	ND	ND	ND	ND	ND	ND
Calumet Sag Channel	316.0	11/IR-11	ND	ND	ND	ND	ND	ND	ND	ND
	305.0	12/IR-12	ND	ND	ND	ND	ND	ND	ND	ND

Table A-2, continued. Concentrations (mg/kg dry weight) of organochlorine compounds detected in sediments collected from the Illinois River in 1989.

Sample Location	River Mile(s)	Sample Number	o,p'DDE	p,p'DDE	o,p'DDD	p,p'DDD	o,p'DDT	p,p'DDT
North Shore Channel		1/IR-1	ND	0.15	0.06	0.35	ND	0.07
		2/IR-2	ND	0.03	0.01	0.00	ND	0.01
North Branch, Chicago River	326.4	3/IR-3	ND	0.07	0.07	0.17	ND	0.03
Chicago River (downtown Chicago)	326.2	4/IR-4	ND	0.03	ND	0.10	ND	0.06
South Branch, Chicago River	326.0	5/IR-5	ND	0.05	ND	0.14	ND	0.03
Little Calumet River (at Grand Calumet)	327.0	6/IR-6	No data collected					
Calumet River (at Grand Calumet)		7/IR-7	ND	0.01	ND	ND	ND	ND
Grand Calumet River (at Calumet River)	327.5	8/IR-8	ND	ND	ND	ND	ND	ND
Little Calumet River (Calumet Sewage treatment plant vicinity)	322.0	9/IR-9	ND	ND	ND	ND	ND	ND
	320.6	10/IR-10	ND	ND	ND	ND	ND	ND
Calumet Sag Channel	316.0	11/IR-11	ND	ND	ND	ND	ND	ND
	305.0	12/IR-12	ND	0.02	ND	ND	ND	ND

Table A-2, continued. Concentrations (mg/kg dry weight) of organochlorine compounds detected in sediments collected from the Illinois River in 1989.

Sample Location	River Mile(s)	Sample Number	Arochlor 1242	Arochlor 1248	Arochlor 1254	Arochlor 1260	Toxaphene
North Shore Channel							
		1/IR-1	ND	ND	ND	ND	ND
		2/IR-2	ND	ND	ND	ND	ND
North Branch, Chicago River							
	326.4	3/IR-3	ND	1.1	ND	0.28	ND
Chicago River (downtown Chicago)							
	326.2	4/IR-4	ND	ND	0.04	0.69	ND
South Branch, Chicago River							
	326.0	5/IR-5	ND	ND	0.29	0.28	ND
Little Calumet River (at Grand Calumet)							
	327.0	6/IR-6	No data collected				
Calumet River (at Grand Calumet)							
		7/IR-7	ND	1.3	ND	ND	ND
Grand Calumet River (at Calumet River)							
	327.5	8/IR-8	ND	ND	ND	ND	ND
Little Calumet River (Calumet Sewage treatment plant vicinity)							
	322.0	9/IR-9	ND	ND	ND	ND	ND
	320.6	10/IR-10	ND	ND	ND	ND	ND
Calumet Sag Channel							
	316.0	11/IR-11	ND	0.76	ND	ND	ND
	305.0	12/IR-12	ND	ND	0.14	0.08	ND

Table A-2, continued. Concentrations (mg/kg dry weight) of organochlorine compounds detected in sediments collected from the Illinois River in 1989.

Sample Location	River Mile(s)	Sample Number	Sample Wt.	%Moisture	HCB	Alpha BHC	Beta BHC	Gamma BHC	Delta BHC	Heptachlor Epoxide
Chicago Sanitary and Ship Canal										
	317.2	13/IR-13	916.0	41.0	ND	ND	ND	ND	ND	ND
	313.2	14/IR-14	614.0	53.4	ND	ND	ND	ND	ND	ND
	305.0	15/IR-15	554.0	74.2	ND	ND	ND	ND	ND	ND
	293.2	16/IR-16	471.0	38.4	ND	ND	ND	ND	ND	ND
Kankakee River										
		17/IR-17	815	38.4	ND	ND	ND	ND	ND	ND
		18								
Des Plaines River										
		19								
		20/IR-20	937	13.2	ND	ND	ND	ND	ND	ND
	286.0	21/IR-21	714	61.2	ND	ND	ND	ND	ND	ND
Fox River										
		22/IR-22	707	57.4	ND	ND	ND	ND	ND	ND
		23/IR-23	817	41.6	ND	ND	ND	ND	ND	ND
Illinois River/ Treats Island										
	279.8	24/IR-24	814	47.0	ND	ND	ND	ND	ND	ND
Illinois River/ Channahon										
	278.0	25/IR-25	715	50.8	ND	ND	ND	ND	ND	ND
Peoria Lake										
	175.0	26/IR-33	1120	25.2	ND	ND	ND	ND	ND	ND
	176.0	27/IR-26	759	61.8	ND	ND	ND	ND	ND	ND
Illinois River/ Mapleton										
		28/IR-27	No data collected							
Illinois River/ Kingston Mines										
	152.5	29/IR-28	853	44.6	ND	ND	ND	ND	ND	ND

Table A-2, continued. Concentrations (mg/kg dry weight) of organochlorine compounds detected in sediments collected from the Illinois River in 1989.

Sample Location	River Mile(s)	Sample Number	Oxy-chlordane	Alpha-chlordane	Gamma chlordane	Cis-Nonachlor	Trans-Nonachlor	Dieldrin	Endrin	Mirex
Chicago Sanitary and Ship Canal										
	317.2	13/IR-13	ND	ND	ND	ND	ND	ND	ND	ND
	313.2	14/IR-14	ND	ND	ND	ND	ND	ND	ND	ND
	305.0	15/IR-15	ND	ND	ND	ND	ND	ND	ND	ND
	293.2	16/IR-16	ND	ND	ND	ND	ND	ND	ND	ND
Kankakee River										
		17/IR-17	ND	ND	ND	ND	ND	ND	ND	ND
		18								
Des Plaines River										
		19								
		20/IR-20	ND	0.01	0.01	ND	0.01	ND	ND	ND
	286.0	21/IR-21	ND	0.02	0.01	ND	0.02	ND	ND	ND
Fox River										
		22/IR-22	ND	ND	ND	ND	ND	ND	ND	ND
		23/IR-23	ND	ND	ND	ND	ND	ND	ND	ND
Illinois River/ Treats Island										
	279.8	24/IR-24	ND	ND	ND	ND	ND	ND	ND	ND
Illinois River/ Channahon										
	278.0	25/IR-25	ND	ND	ND	ND	ND	ND	ND	ND
Peoria Lake										
	175.0	26/IR-33	ND	ND	ND	ND	ND	ND	ND	ND
	176.0	27/IR-26	ND	ND	ND	ND	ND	ND	ND	ND
Illinois River/ Mapleton										
		28/IR-27								
Illinois River/ Kingston Mines										
	152.5	29/IR-28	ND	ND	ND	ND	ND	ND	ND	ND

Table A-2, continued. Concentrations (mg/kg dry weight) of organochlorine compounds detected in sediments collected from the Illinois River in 1989.

Sample Location	River Mile(s)	Sample Number	o,p'DDE	p,p'DDE	o,p'DDD	p,p'DDD	o,p'DDT	p,p'DDT
Chicago Sanitary and Ship Canal								
	317.2	13/IR-13	ND	0.06	ND	ND	ND	ND
	313.2	14/IR-14	ND	0.04	ND	ND	ND	ND
	305.0	15/IR-15	ND	0.04	ND	ND	ND	ND
	293.2	16/IR-16	ND	0.04	ND	ND	ND	ND
Kankakee River								
		17/IR-17	ND	ND	ND	ND	ND	ND
		18						
Des Plaines River								
		19						
		20/IR-20ND	ND	0.03	0.04	0.25	ND	0.02
	286.0	21/IR-21	ND	0.04	0.04	0.04	ND	0.01
Fox River								
		22/IR-22	ND	0.02	ND	ND	ND	ND
		23/IR-23	ND	ND	ND	ND	ND	ND
Illinois River/ Treats Island								
	279.8	24/IR-24	ND	0.02	ND	0.02	ND	ND
Illinois River/ Channahon								
	278.0	25/IR-25	ND	0.02	ND	0.02	ND	ND
Peoria Lake								
	175.0	26/IR-33	ND	ND	ND	ND	ND	ND
	176.0	27/IR-26	ND	ND	ND	ND	ND	ND
Illinois River/ Mapleton								
		28/IR-27	No data collected					
Illinois River/ Kingston Mines								
	152.5	29/IR-28	ND	ND	ND	ND	ND	ND

Table A-2, continued. Concentrations (mg/kg dry weight) of organochlorine compounds detected in sediments collected from the Illinois River in 1989.

Sample Location	River Mile(s)	Sample Number	Arochlor 1242	Arochlor 1248	Arochlor 1254	Arochlor 1260	Toxaphene
Chicago Sanitary and Ship Canal							
	317.2	13/IR-13	ND	4.1	1.2	2.4	ND
	313.2	14/IR-14	ND	0.77	0.42	0.43	ND
	305.0	15/IR-15	ND	0.75	0.23	0.59	ND
	293.2	16/IR-16	ND	0.88	0.36	0.30	ND
Kankakee River							
		17/IR-17	ND	ND	ND	ND	ND
		18					
Des Plaines River							
		19					
		20/IR-20	ND	ND	ND	0.10	ND
	286.0	21/IR-21	ND	ND	0.26	0.22	ND
Fox River							
		22/IR-22	ND	ND	ND	ND	ND
		23/IR-23	ND	ND	ND	ND	ND
Illinois River/ Treats Island							
	279.8	24/IR-24	ND	ND	ND	ND	ND
Illinois River/ Channahon							
	278.0	25/IR-25	ND	ND	ND	ND	ND
Peoria Lake							
	175.0	26/IR-33	ND	ND	ND	ND	ND
	176.0	27/IR-26	ND	ND	ND	ND	ND
Illinois River/ Mapleton							
		28/IR-27	No data collected				
Illinois River/ Kingston Mines							
	152.5	29/IR-28	ND	ND	ND	ND	ND

Table A-2, continued. Concentrations (mg/kg dry weight) of organochlorine compounds detected in sediments collected from the Illinois River in 1989.

Sample Location	River Mile(s)	Sample Number	Sample Wt.	%Moisture	HCB	Alpha BHC	Beta BHC	Gamma BHC	Delta BHC	Heptachlor Epoxide
Chautauqua NWR										
	127-122	30/IR-29	805	08.8	ND	ND	ND	ND	ND	ND
		31/EMP-29	1010	48.2	ND	ND	ND	ND	ND	ND
		32/IR-30	922	54.4	ND	ND	ND	ND	ND	ND
Mark Twain NWR										
Brussels District										
Swan Lake										
	12-5	33/IR-31A	821	43.4	ND	ND	ND	ND	ND	ND
		34/IR-31B	832	51.8	ND	ND	ND	ND	ND	ND
		35/IR-32	595	13.6	ND	ND	ND	ND	ND	ND
		36/IR-34	579	4.0	ND	ND	ND	ND	ND	ND

Table A-2, continued. Concentrations (mg/kg dry weight) of organochlorine compounds detected in sediments collected from the Illinois River in 1989.

Sample Location	River Mile(s)	Sample Number	Oxy-chlordane	Alpha-chlordane	Gamma chlordane	Cis-Nonachlor	Trans-Nonachlor	Dieldrin	Endrin	Mirex
Chautauqua NWR										
	127-122	30/IR-29	ND	ND	ND	ND	ND	ND	ND	ND
		31/EMP-29	ND	ND	ND	ND	ND	ND	ND	ND
		32/IR-30	ND	ND	ND	ND	ND	ND	ND	ND
Mark Twain NWR										
Brussels District										
Swan Lake										
	12-5	33/IR-31A	ND	ND	ND	ND	ND	ND	ND	ND
		34/IR-31B	ND	ND	ND	ND	ND	ND	ND	ND
		35/IR-32	ND	ND	ND	ND	ND	ND	ND	ND
		36/IR-34	ND	ND	ND	ND	ND	ND	ND	ND

Table A-2, continued. Concentrations (mg/kg dry weight) of organochlorine compounds detected in sediments collected from the Illinois River in 1989.

Sample Location	River Mile(s)	Sample Number	o,p'DDE	p,p'DDE	o,p'DDD	p,p'DDD	o,p'DDT	p,p'DDT
Chautauqua NWR								
	127-122	30/IR-29	ND	0.09	ND	0.03	ND	ND
		31/EMP-29	ND	ND	ND	ND	ND	ND
		32/IR-30	ND	ND	ND	ND	ND	ND
Mark Twain NWR								
Brussels District								
Swan Lake								
	12-5	33/IR-31A	ND	ND	ND	ND	ND	ND
		34/IR-31B	ND	ND	ND	ND	ND	ND
		35/IR-32	ND	ND	ND	ND	ND	ND
		36/IR-34	ND	ND	ND	ND	ND	ND

Table A-2, continued. Concentrations (mg/kg dry weight) of organochlorine compounds detected in sediments collected from the Illinois River in 1989.

Sample Location	River Mile(s)	Sample Number	Arochlor 1242	Arochlor 1248	Arochlor 1254	Arochlor 1260	Toxaphene
Chautauqua NWR							
	127-122	30/IR-29	ND	ND	ND	ND	ND
		31/EMP-29	ND	ND	ND	ND	ND
		32/IR-30	ND	ND	ND	ND	ND
Mark Twain NWR							
Brussels District							
Swan Lake							
	12-5	33/IR-31A	ND	ND	ND	ND	ND
		34/IR-31B	ND	ND	ND	ND	ND
		35/IR-32	ND	ND	ND	ND	ND
		36/IR-34	ND	ND	ND	ND	ND

Table A-3. Concentrations (mg/kg dry weight) of polycyclic aromatic hydrocarbons (PAH's), oil, and grease detected in sediments collected from the Illinois River in 1989.

Sample Location	River Mile(s)	Sample Number	Sample Weight	%Moisture	Napthalene	Fluorene	Phenanthrene	Anthracene
North Shore Channel								
		1/IR-1	650.0	50.4	0.26	0.40	1.98	0.32
		2/IR-2	827.0	38.6	0.13	0.41	1.95	0.52
North Branch, Chicago River								
	326.4	3/IR-3	543.0	53.0	0.29	0.36	4.89	0.91
Chicago River (downtown Chicago)								
	326.2	4/IR-4	604.0	43.2	0.98	2.28	11.26	0.73
South Branch, Chicago River								
	326.0	5/IR-5	572.0	59.8	0.77	0.87	12.93	0.79
Little Calumet River (at Grand Calumet)								
	327.0	6/IR-6	No Data Collected					
Calumet River (at Grand Calumet)								
		7/IR-7	764.0	56.0	0.52	0.13	1.25	0.11
Grand Calumet River (at Calumet River)								
	327.5	8/IR-8	790.0	46.2	0.29	0.39	1.37	0.07
Little Calumet River (Calumet Sewage treatment plant vicinity)								
	322.0	9/IR-9	700	53.2	0.34	0.23	1.21	0.23
	320.6	10/IR-10	749	65.0	0.71	0.37	3.71	1.45
Calumet Sag Channel								
	316.0	11/IR-11	902	33.8	0.40	0.31	1.96	0.55
	305.0	12/IR-12	916.0	41.0	0.13	0.15	0.89	0.25

Table A-3, continued. Concentrations (mg/kg dry weight) of polycyclic aromatic hydrocarbons (PAH's), oil, and grease detected in sediments collected from the Illinois River in 1989.

Sample Location	River Mile(s)	Sample Number	Fluoranthrene	Pyrene	1,2-benzanthracene	Chrysene	Benzo(b)flouranthrene
North Shore Channel							
		1/IR-1	2.01	1.83	0.50	0.72	0.68
		2/IR-2	1.95	1.95	0.78	0.92	0.68
North Branch, Chicago River							
	326.4	3/IR-3	4.04	4.46	1.46	1.14	2.08
Chicago River (downtown Chicago)							
	326.2	4/IR-4	4.40	4.22	1.51	1.44	1.39
South Branch, Chicago River							
	326.0	5/IR-5	5.47	5.97	2.18	2.31	2.43
Little Calumet River (at Grand Calumet)							
	327.0	6/IR-6	No Data Collected				
Calumet River (at Grand Calumet)							
		7/IR-7	1.22	1.20	0.47	0.50	0.50
Grand Calumet River (at Calumet River)							
	327.5	8/IR-8	0.89	0.76	0.31	0.52	0.29
Little Calumet River (Calumet Sewage treatment plant vicinity)							
	322.0	9/IR-9	1.26	1.36	0.64	0.40	0.74
	320.6	10/IR-10	5.14	6.28	2.48	2.62	2.31
Calumet Sag Channel							
	316.0	11/IR-11	2.56	3.17	0.64	0.93	0.57
	305.0	12/IR-12	1.35	1.49	0.44	0.66	0.32

Table A-3, continued. Concentrations (mg/kg dry weight) of polycyclic aromatic hydrocarbons (PAH's), oil, and grease detected in sediments collected from the Illinois River in 1989.

Sample Location	River Mile(s)	Sample Number	Benzo(k)fluoranthrene	Benzo(e)pyrene	Benzo(a)pyrene	1,2,5,6-dibenzanthracene
North Shore Channel						
		1/IR-1	0.24	0.56	0.82	0.16
		2/IR-2	0.21	0.40	0.74	0.12
North Branch, Chicago River						
	326.4	3/IR-3	0.38	0.79	1.1	0.18
Chicago River (downtown Chicago)						
	326.2	4/IR-4	0.26	0.92	1.1	0.22
South Branch, Chicago River						
	326.0	5/IR-5	0.32	1.0	1.2	0.08
Little Calumet River (at Grand Calumet)						
	327.0	6/IR-6	No Data Collected			
Calumet River (at Grand Calumet)						
		7/IR-7	0.09	0.12	0.32	0.08
Grand Calumet River (at Calumet River)						
	327.5	8/IR-8	0.05	0.12	0.16	0.04
Little Calumet River (Calumet Sewage treatment plant vicinity)						
	322.0	9/IR-9	0.14	0.33	0.46	0.12
	320.6	10/IR-10	0.34	0.63	1.2	0.16
Calumet Sag Channel						
	316.0	11/IR-11	0.17	0.30	0.55	0.08
	305.0	12/IR-12	0.09	0.28	0.20	0.08

Table A-3, continued. Concentrations (mg/kg dry weight) of polycyclic aromatic hydrocarbons (PAH's), oil, and grease detected in sediments collected from the Illinois River in 1989.

Sample Location	River Mile(s)	Sample Number	Benzo(g,h,i)perylene	Oil/ Grease
North Shore Channel				
		1/IR-1	0.54	15181
		2/IR-2	0.55	5684
North Branch, Chicago River				
	326.4	3/IR-3	1.44	18659
Chicago River (downtown Chicago)				
	326.2	4/IR-4	1.39	8204
South Branch, Chicago River				
	326.0	5/IR-5	1.89	19079
Little Calumet River (at Grand Calumet)				
	327.0	6/IR-6	No Data Collected	
Calumet River (at Grand Calumet)				
		7/IR-7	0.43	2295
Grand Calumet River (at Calumet River)				
	327.5	8/IR-8	0.20	4981
Little Calumet River (Calumet Sewage treatment plant vicinity)				
	322.0	9/IR-9	0.83	5299
	320.6	10/IR-10	1.28	24657
Calumet Sag Channel				
	316.0	11/IR-11	0.43	7084
	305.0	12/IR-12	0.38	5389

Table A-3, continued. Concentrations (mg/kg dry weight) of polycyclic aromatic hydrocarbons (PAH's), oil, and grease detected in sediments collected from the Illinois River in 1989.

Sample Location	River Mile(s)	Sample Number	Sample Weight	%Moisture	Napthalene	Fluorene	Phenanthrene	Anthracene
Chicago Sanitary and Ship Canal								
	317.2	13/IR-13	916.0	41.0	0.95	1.5	7.8	1.4
	313.2	14/IR-14	614.0	53.4	0.96	1.1	3.3	1.0
	305.0	15/IR-15	555.0	74.2	0.76	0.58	1.5	0.67
	293.2	16/IR-16	471.0	38.4	0.01	0.02	0.46	0.23
Kankakee River								
		17/IR-17	815.0	38.4	0.01	0.01	0.13	0.02
		18						
Des Plaines River								
		19						
		20/IR-20	937.0	13.2	0.03	0.17	1.9	0.04
	286.0	21/IR-21	714.0	61.2	0.06	0.03	0.39	0.77
Fox River								
		22/IR-22	707.0	57.4	0.01	0.02	0.30	0.04
		23/IR-23	817.0	41.6	ND	ND	0.03	ND
Illinois River/ Treats Island								
	279.8	24/IR-24	814.0	47.0	0.03	0.03	0.47	0.75
Illinois River/ Channahon								
	278.0	25/IR-25	715.0	50.8	0.02	0.02	0.21	0.60
Peoria Lake								
	175.0	26/IR-33	1120.0	25.0	0.02	0.01	0.10	0.04
	176.0	27/IR-26	759.0	61.8	0.01	0.01	0.09	0.02
Illinois River/ Mapleton								
		28/IR-27	No Data Collected					
Illinois River/ Kingston Mines								
	152.5	29/IR-28	853.0	44.6	0.01	0.01	0.05	0.01

Table A-3, continued. Concentrations (mg/kg dry weight) of polycyclic aromatic hydrocarbons (PAH's), oil, and grease detected in sediments collected from the Illinois River in 1989.

Sample Location	River Mile(s)	Sample Number	Fluoranthrene	Pyrene	1,2-benzanthracene	Chrysene	Benzo(b)flouranthrene
Chicago Sanitary and Ship Canal							
	317.2	13/IR-13	6.4	4.8	1.4	1.9	2.2
	313.2	14/IR-14	3.3	2.4	0.77	0.99	0.70
	305.0	15/IR-15	2.3	2.1	0.60	0.88	0.53
	293.2	16/IR-16	1.3	1.5	0.30	0.45	0.30
Kankakee River							
		17/IR-17	0.16	0.14	0.04	0.05	0.04
		18					
Des Plaines River							
		19					
		20/IR-20	1.9	1.4	0.31	0.45	0.35
	286.0	21/IR-21	4.3	2.8	2.0	2.6	1.1
Fox River							
		22/IR-22	0.40	0.29	0.08	0.11	0.09
		23/IR-23	0.07	0.06	0.01	0.02	0.02
Illinois River/ Treats Island							
	279.8	24/IR-24	2.8	3.8	0.95	1.2	0.94
Illinois River/ Channahon							
	278.0	25/IR-25	4.4	2.4	2.2	2.5	2.3
Peoria Lake							
	175.0	26/IR-33	0.17	0.27	0.10	0.16	0.10
	176.0	27/IR-26	0.21	0.25	0.08	0.12	0.09
Illinois River/ Mapleton							
		28/IR-27	No Data Collected				
Illinois River/ Kingston Mines							
	152.5	29/IR-28	0.10	0.14	0.03	0.05	0.04

Table A-3, continued. Concentrations (mg/kg dry weight) of polycyclic aromatic hydrocarbons (PAH's), oil, and grease detected in sediments collected from the Illinois River in 1989.

Sample Location	River Mile(s)	Sample Number	Benzo(k)fluoranthrene	Benzo(e)pyrene	Benzo(a)pyrene	1,2,5,6-dibenzanthracene
Chicago Sanitary and Ship Canal						
	317.2	13/IR-13	0.68	1.5	2.1	0.31
	313.2	14/IR-14	0.33	0.65	0.15	0.15
	305.0	15/IR-15	0.22	0.41	0.66	0.10
	293.2	16/IR-16	0.11	0.26	0.39	0.07
Kankakee River						
		17/IR-17	0.02	0.03	0.07	0.01
		18				
Des Plaines River						
		19				
		20/IR-20	0.12	0.29	0.38	0.07
	286.0	21/IR-21	0.95	1.6	2.5	0.34
Fox River						
		22/IR-22	0.04	0.06	0.16	0.03
		23/IR-23	0.01	0.01	0.05	0.07
Illinois River/ Treats Island						
	279.8	24/IR-24	0.39	0.89	1.3	0.18
Illinois River/ Channahon						
	278.0	25/IR-25	1.0	1.7	3.0	0.38
Peoria Lake						
	175.0	26/IR-33	0.05	0.10	0.12	0.03
	176.0	27/IR-26	0.04	0.08	0.14	0.02
Illinois River/ Mapleton						
		28/IR-27	No Data Collected			
Illinois River/ Kingston Mines						
	152.5	29/IR-28	0.02	0.03	0.06	0.02

Table A-3, continued. Concentrations (mg/kg dry weight) of polycyclic aromatic hydrocarbons (PAH's), oil, and grease detected in sediments collected from the Illinois River in 1989.

Sample Location	River Mile(s)	Sample Number	Benzo(g,h,i,)perylene	Oil/ Grease
Chicago Sanitary and Ship Canal				
	317.2	13/IR-13	2.03	8796
	313.2	14/IR-14	1.15	8862
	305.0	15/IR-15	1.51	74108
	293.2	16/IR-16	0.35	6785
Kankakee River				
		17/IR-17	0.11	909
		18		
Des Plaines River				
		19		
		20/IR-20	0.29	1232
	286.0	21/IR-21	3.09	13195
Fox River				
		22/IR-22	0.25	1760
		23/IR-23	0.10	428
Illinois River/ Treats Island				
	279.8	24/IR-24	1.22	4490
Illinois River/ Channahon				
	278.0	25/IR-25	3.04	3963
Peoria Lake				
	175.0	26/IR-33	0.14	346
	176.0	27/IR-26	0.23	1020
Illinois River/ Mapleton				
		28/IR-27		No Data Collected
Illinois River/ Kingston Mines				
	152.5	29/IR-28	0.28	595

Table A-3, continued. Concentrations (mg/kg dry weight) of polycyclic aromatic hydrocarbons (PAH's), oil, and grease detected in sediments collected from the Illinois River in 1989.

Sample Location	River Mile(s)	Sample Number	Sample Weight	%Moisture	Napthalene	Fluorene	Phenanthrene	Anthracene
Chautauqua NWR								
	127-122	30/IR-29	805.0	8.8	ND	ND	ND	ND
		31/EMP-29	1010	48.2	ND	ND	0.01	ND
		32/IR-30	922.0	54.4	ND	ND	ND	ND
Mark Twain NWR								
Brussels District								
Swan Lake								
	12-5	33/IR-31A	821.0	43.4	ND	ND	ND	ND
		34/IR-31B	832.0	51.8	ND	ND	ND	ND
		35/IR-32	595.0	13.6	ND	ND	ND	ND
		36/IR-34	579.0	4.0	ND	ND	ND	ND

Table A-3, continued. Concentrations (mg/kg dry weight) of polycyclic aromatic hydrocarbons (PAH's), oil, and grease detected in sediments collected from the Illinois River in 1989.

Sample Location	River Mile(s)	Sample Number	Fluoranthrene	Pyrene	1,2-benzanthracene	Chrysene	Benzo(b)flouranthrene
Chautauqua NWR							
	127-122	30/IR-29	0.03	0.04	ND	ND	0.01
		31/EMP-29	0.02	0.03	ND	0.01	0.01
		32/IR-30	0.01	0.01	ND	ND	ND
Mark Twain NWR							
Brussels District							
Swan Lake							
	12-5	33/IR-31A	0.02	0.04	ND	0.01	0.01
		34/IR-31B	0.01	0.01	ND	ND	ND
		35/IR-32	0.01	0.01	ND	ND	ND
		36/IR-34	ND	ND	ND	ND	ND

Table A-3, continued. Concentrations (mg/kg dry weight) of polycyclic aromatic hydrocarbons (PAH's), oil, and grease detected in sediments collected from the Illinois River in 1989.

Sample Location	River Mile(s)	Sample Number	Benzo(k)fluoranthrene	Benzo(e)pyrene	Benzo(a)pyrene	1,2,5,6-dibenzanthracene
Chautauqua NWR						
	127-122	30/IR-29	ND	ND	0.02	ND
		31/EMP-29	ND	ND	0.01	ND
		32/IR-30	ND	ND	ND	ND
Mark Twain NWR						
Brussels District						
Swan Lake						
	12-5	33/IR-31A	ND	ND	0.01	ND
		34/IR-31B	ND	ND	ND	ND
		35/IR-32	ND	ND	0.01	ND
		36/IR-34	ND	ND	ND	ND

Table A-3, continued. Concentrations (mg/kg dry weight) of polycyclic aromatic hydrocarbons (PAH's), oil, and grease detected in sediments collected from the Illinois River in 1989.

Sample Location	River Mile(s)	Sample Number	Benzo(g,h,i)perylene	Oil/ Grease
Chautauqua NWR				
	127-122	30/IR-29	ND	372.8
		31/EMP-29	3.86	463
		32/IR-30	0.02	745
Mark Twain NWR				
Brussels District				
Swan Lake				
	12-5	33/IR-31A	ND	300
		34/IR-31B	ND	145
		35/IR-32	ND	381
		36/IR-34	ND	291.6

APPENDIX B

FISH DATA

Table B-1. Concentrations (mg/kg dry weight) of inorganic elements detected in carp collected from the Illinois River in 1989.

Sample Location	River Mile(s)	Sample Number	Sample Wt.	%Moisture	Cd	Cr	Cu	Pb	Hg	Ni	Se
Chicago River (downtown Chicago)											
	326.2	4/IR-4	7049.0	68.0	0.11	0.33	4.2	9.6	0.11	0.36	1.2
Little Calumet River (Calumet Sewage treatment plant vicinity)											
	322.0	9/IR-9									
	320.6	10/IR-10	3464.0	61.0	0.062	0.36	3.0	0.83	0.17	<0.1	1.2
Kankakee River											
		17/IR-17	No data collected								
		18	4968.0	71.5	0.24	3.2	6.5	1.3	0.12	2.7	2.4
Des Plaines River											
		19	No data collected								
		20/IR-20	6802.0	60.5	0.13	0.32	3.7	12.3	0.18	<0.1	1.2
	286.0	21/IR-21	9151.0	64.3	0.16	1.0	3.5	0.89	0.13	0.3	1.5
Fox River											
		22/IR-22	5557.0	70.9	0.21	0.63	3.7	2.1	0.20	0.2	1.4
		23/IR-23									
Illinois River/ Treats Island											
	279.8	24/IR-24	4219.0	74.8	0.24	1.8	11.1	1.6	0.10	2.0	2.8
Peoria Lake											
	175.0	26/IR-33	3044.0	67.7	0.21	0.31	3.5	1.1	0.20	0.1	1.5
	176.0	27/IR-26	4801.0	70.6	0.23	0.56	4.9	1.7	0.19	0.33	1.7
Chautauqua NWR											
	127-122	30/IR-29	No data collected								
		31/EMP-29									
		32/IR-30	5020.0	69.4	0.16	0.41	3.0	0.76	0.17	0.34	2.1
Mark Twain NWR Brussels District Swan Lake											
	12-5	33/IR-31A	9511.0	68.4	0.18	0.68	4.5	0.46	0.25	0.35	1.8
		34/IR-31B	No data collected								
		35/IR-32									
		36/IR-34									

Table B-2. Concentrations (mg/kg wet weight) of organochlorine compounds detected in carp collected from the Illinois River in 1989.

Sample Location	River Mile(s)	Sample Number	Sample Wt.	%Moisture	HCB	Alpha BHC	Beta BHC	Gamma BHC	Delta BHC	Heptachlor Epoxide
North Shore Channel		1/IR-1			No data collected for blank entries					
		2/IR-2								
North Branch, Chicago River	326.4	3/IR-3								
Chicago River (downtown Chicago)	326.2	4/IR-4	7049.0	68.0	0.003	0.006	ND	ND	ND	0.02
South Branch, Chicago River	326.0	5/IR-5								
Little Calumet River (at Grand Calumet)	327.0	6/IR-6								
Calumet River (at Grand Calumet)		7/IR-7								
Grand Calumet River (at Calumet River)	327.5	8/IR-8								
Little Calumet River (Calumet Sewage treatment plant vicinity)	322.0	9/IR-9								
	320.6	10/IR-10	3464.0	61.0	0.0009	ND	ND	0.011	ND	0.019
Calumet Sag Channel	316.0	11/IR-11								
	305.0	12/IR-12								

Table B-2 continued. Concentrations (mg/kg wet weight) of organochlorine compounds detected in carp collected from the Illinois River in 1989.

Sample Location	River Mile(s)	Sample Number	Oxy-chlordane	Alpha-chlordane	Gamma chlordane	Cis-Nonachlor	Trans-Nonachlor	Dieldrin	Endrin	Mirex
North Shore Channel										
		1/IR-1								
		2/IR-2								
North Branch, Chicago River	326.4	3/IR-3								
Chicago River (downtown Chicago)	326.2	4/IR-4	0.0064	0.070	0.054	ND	0.054	0.022	ND	ND
South Branch, Chicago River	326.0	5/IR-5								
Little Calumet River (at Grand Calumet)	327.0	6/IR-6								
Calumet River (at Grand Calumet)		7/IR-7								
Grand Calumet River (at Calumet River)	327.5	8/IR-8								
Little Calumet River (Calumet Sewage treatment plant vicinity)	322.0	9/IR-9								
	320.6	10/IR-10	ND	0.03	0.04	ND	0.02	0.05	ND	ND
Calumet Sag Channel	316.0	11/IR-11								
	305.0	12/IR-12								

Table B-2 continued. Concentrations (mg/kg wet weight) of organochlorine compounds detected in carp collected from the Illinois River in 1989.

Sample Location	River Mile(s)	Sample Number	o,p'DDE	p,p'DDE	o,p'DDD	p,p'DDD	o,p'DDT	p,p'DDT
North Shore Channel		1/IR-1						
		2/IR-2						
North Branch, Chicago River	326.4	3/IR-3						
Chicago River (downtown Chicago)	326.2	4/IR-4	ND	0.19	0.06	0.31	ND	0.0064
South Branch, Chicago River	326.0	5/IR-5						
Little Calumet River (at Grand Calumet)	327.0	6/IR-6						
Calumet River (at Grand Calumet)		7/IR-7						
Grand Calumet River (at Calumet River)	327.5	8/IR-8						
Little Calumet River (Calumet Sewage treatment plant vicinity)	322.0	9/IR-9						
	320.6	10/IR-10	ND	0.23	0.03	0.19	ND	0.0039
Calumet Sag Channel	316.0	11/IR-11						
	305.0	12/IR-12						

Table B-2 continued. Concentrations (mg/kg wet weight) of organochlorine compounds detected in carp collected from the Illinois River in 1989.

Sample Location	River Mile(s)	Sample Number	Arochlor 1242	Arochlor 1248	Arochlor 1254	Arochlor 1260	Toxaphene
North Shore Channel		1/IR-1					
		2/IR-2					
North Branch, Chicago River	326.4	3/IR-3					
Chicago River (downtown Chicago)	326.2	4/IR-4	ND	0.44	0.73	0.30	ND
South Branch, Chicago River	326.0	5/IR-5					
Little Calumet River (at Grand Calumet)	327.0	6/IR-6					
Calumet River (at Grand Calumet)		7/IR-7					
Grand Calumet River (at Calumet River)	327.5	8/IR-8					
Little Calumet River (Calumet Sewage treatment plant vicinity)	322.0	9/IR-9					
	320.6	10/IR-10	ND	0.30	0.34	0.12	ND
Calumet Sag Channel	316.0	11/IR-11					
	305.0	12/IR-12					

Table B-2 continued. Concentrations (mg/kg wet weight) of organochlorine compounds detected in carp collected from the Illinois River in 1989.

Sample Location	River Mile(s)	Sample Number	Sample Wt.	%Moisture	HCB	Alpha BHC	Beta BHC	Gamma BHC	Delta BHC	Heptachlor Epoxide
Chicago Sanitary and Ship Canal										
	317.2	13/IR-13								
	313.2	14/IR-14								
	305.0	15/IR-15								
	293.2	16/IR-16								
Kankakee River										
		17/IR-17								
		18	4968.0	71.0	ND	ND	ND	0.0029	ND	0.02
Des Plaines River										
		19								
		20/IR-20	6802.0	60.2	0.0039	ND	ND	0.003	ND	0.02
	286.0	21/IR-21	9151.0	64.3	0.01	ND	ND	0.0071	ND	0.017
Fox River										
		22/IR-22	5557.0	70.9	ND	ND	ND	ND	ND	0.008
		23/IR-23								
Illinois River/ Treats Island										
	279.8	24/IR-24	4219.0	74.8	ND	ND	ND	ND	ND	0.005
Illinois River/ Channahon										
	278.0	25/IR-25								
Peoria Lake										
	175.0	26/IR-33	3044.0	67.7	ND	ND	ND	ND	ND	0.016
	176.0	27/IR-26	4801.0	70.6	ND	ND	ND	0.011		
Illinois River/ Mapleton										
		28/IR-27								
Illinois River/ Kingston Mines										
	152.5	29/IR-28								

Table B-2 continued. Concentrations (mg/kg wet weight) of organochlorine compounds detected in carp collected from the Illinois River in 1989.

Sample Location	River Mile(s)	Sample Number	Oxy-chlordane	Alpha-chlordane	Gamma chlordane	Cis-Nonachlor	Trans-Nonachlor	Dieldrin	Endrin	Mirex
Chicago Sanitary and Ship Canal										
	317.2	13/IR-13								
	313.2	14/IR-14								
	305.0	15/IR-15								
	293.2	16/IR-16								
Kankakee River										
		17/IR-17								
		18	ND	0.03	0.02	ND	0.03	0.01	ND	ND
Des Plaines River										
		19								
		20/IR-20	0.007	0.03	0.03	ND	0.03	0.007	ND	ND
	286.0	21/IR-21	ND	0.03	0.03	ND	0.03	0.01	ND	ND
Fox River										
		22/IR-22	0.005	0.008	0.005	ND	0.11	ND	ND	ND
		23/IR-23								
Illinois River/ Treats Island										
	279.8	24/IR-24	ND	0.01	0.01	ND	0.01	0.007	ND	ND
Illinois River/ Channahon										
	278.0	25/IR-25								
Peoria Lake										
	175.0	26/IR-33								
	176.0	27/IR-26	0.002	0.04	0.03	ND	0.05	0.02	ND	ND
Illinois River/ Mapleton										
		28/IR-27								
Illinois River/ Kingston Mines										
	152.5	29/IR-28								

Table B-2 continued. Concentrations (mg/kg wet weight) of organochlorine compounds detected in carp collected from the Illinois River in 1989.

Sample Location	River Mile(s)	Sample Number	o,p'DDE	p,p'DDE	o,p'DDD	p,p'DDD	o,p'DDT	p,p'DDT
Chicago Sanitary and Ship Canal								
	317.2	13/IR-13						
	313.2	14/IR-14						
	305.0	15/IR-15						
	293.2	16/IR-16						
Kankakee River								
		17/IR-17						
		18	ND	0.10	0.029	0.14	ND	ND
Des Plaines River								
		19						
		20/IR-20	ND	0.25	0.05	0.43	ND	0.003
	286.0	21/IR-21	ND	0.08	0.02	0.13	ND	ND
Fox River								
		22/IR-22	ND	0.08	ND	0.03	ND	ND
		23/IR-23						
Illinois River/ Treats Island								
	279.8	24/IR-24	ND	0.05	0.01	0.05	ND	ND
Illinois River/ Channahon								
	278.0	25/IR-25						
Peoria Lake								
	175.0	26/IR-33						
	176.0	27/IR-26	ND	0.06	0.008	0.06	ND	ND
Illinois River/ Mapleton								
		28/IR-27						
Illinois River/ Kingston Mines								
	152.5	29/IR-28						

Table B-2 continued. Concentrations (mg/kg wet weight) of organochlorine compounds detected in carp collected from the Illinois River in 1989.

Sample Location	River Mile(s)	Sample Number	Arochlor 1242	Arochlor 1248	Arochlor 1254	Arochlor 1260	Toxaphene
Chicago Sanitary and Ship Canal							
	317.2	13/IR-13					
	313.2	14/IR-14					
	305.0	15/IR-15					
	293.2	16/IR-16					
Kankakee River							
		17/IR-17					
		18	ND	0.40	0.98	0.46	ND
Des Plaines River							
		19					
		20/IR-20	ND	0.15	0.39	0.21	ND
	286.0	21/IR-21	ND	0.57	0.78	0.34	ND
Fox River							
		22/IR-22	ND	0.02	0.24	0.19	ND
		23/IR-23					
Illinois River/ Treats Island							
	279.8	24/IR-24	ND	0.22	0.57	0.27	ND
Illinois River/ Channahon							
	278.0	25/IR-25					
Peoria Lake							
	175.0	26/IR-33	ND	0.03	0.74	0.45	ND
	176.0	27/IR-26	ND	0.11	0.55	0.35	ND
Illinois River/ Mapleton							
		28/IR-27					
Illinois River/ Kingston Mines							
	152.5	29/IR-28					

Table B-2 continued. Concentrations (mg/kg wet weight) of organochlorine compounds detected in carp collected from the Illinois River in 1989.

Sample Location	River Mile(s)	Sample Number	Sample Wt.	%Moisture	HCB	Alpha BHC	Beta BHC	Gamma BHC	Delta BHC	Heptachlor Epoxide
Chautauqua NWR										
	127-122	30/IR-29	973.0	74.3	ND	ND	ND	ND	ND	0.002
		31/EMP-29								
		32/IR-30	5020.0	69.4	ND	ND	ND	ND	ND	ND
Mark Twain NWR										
Brussels District										
Swan Lake										
	12-5	33/IR-31A	9511.0	68.4	ND	ND	ND	ND	ND	0.009
		34/IR-31B								
		35/IR-32								
		36/IR-34								

Table B-2 continued. Concentrations (mg/kg wet weight) of organochlorine compounds detected in carp collected from the Illinois River in 1989.

Sample Location	River Mile(s)	Sample Number	Oxy-chlordane	Alpha-chlordane	Gamma chlordane	Cis-Nonachlor	Trans-Nonachlor	Dieldrin	Endrin	Mirex
Chautauqua NWR	127-122	30/IR-29 31/EMP-29 32/IR-30	ND	0.005	0.005	ND	0.007	ND	ND	ND
Mark Twain NWR Brussels District Swan Lake	12-5	33/IR-31A 34/IR-31B 35/IR-32 36/IR-34								

Table B-2 continued. Concentrations (mg/kg wet weight) of organochlorine compounds detected in carp collected from the Illinois River in 1989.

Sample Location	River Mile(s)	Sample Number	o,p'DDE	p,p'DDE	o,p'DDD	p,p'DDD	o,p'DDT	p,p'DDT
Chautauqua NWR								
	127-122	30/IR-29 31/EMP-29 32/IR-30	ND	0.02	ND	0.007	ND	ND
Mark Twain NWR Brussels District Swan Lake								
	12-5	33/IR-31A 34/IR-31B 35/IR-32 36/IR-34						

APPENDIX C

WATER CHEMISTRY DATA

Table B-2 continued. Concentrations (mg/kg wet weight) of organochlorine compounds detected in carp collected from the Illinois River in 1989.

Sample Location	River Mile(s)	Sample Number	Arochlor 1242	Arochlor 1248	Arochlor 1254	Arochlor 1260	Toxaphene
Chautauqua NWR							
	127-122	30/IR-29	ND	0.02	0.12	0.06	ND
		31/EMP-29					
		32/IR-30	ND	ND	ND	0.18	ND
Mark Twain NWR							
Brussels District							
Swan Lake							
	12-5	33/IR-31A	ND	0.37	0.08	0.06	ND
		34/IR-31B					
		35/IR-32					
		36/IR-34					

Table C-1. Water chemistry data - solid phase sediment and water 96-hour fathead minnow bioassays of sediments collected from the Illinois River in 1989.

Sample Location	River Mile(s)	Sample Number	Temp (deg.C°)	pH	DO	NH_3-N (mg/L)	Total NH_3 (mg/L)	Unionized NH_3 (mg/L)	Total Hardness (mg/L $CaCO_3$)	Specific Conductance (mmhos)
North Shore Channel		1/IR-1	24	7.8	7.8	4.2	5.1	0.17	200	440
		2/IR-2	24	7.9	7.6	16	19.4	0.8	80	560
North Branch, Chicago River	326.4	3/IR-3	22	7.3	7.8	17	20.7	0.19	145	390
Chicago River (downtown Chicago)	326.2	4/IR-4								
South Branch, Chicago River	326.0	5/IR-5	22	7.5	7.8	9.8	11.9	0.17	200	490
Little Calumet River (at Grand Calumet)	327.0	6/IR-6	22	7.7	7.8	2.8	3.4	0.08	220	475
Calumet River (at Grand Calumet)		7/IR-7	22	7.5	7.7	13	15.8	0.03	205	570
Grand Calumet River (at Calumet River)	327.5	8/IR-8	22	7.6	8.1	8.5	10.3	0.19	190	540
Little Calumet River (Calumet Sewage treatment plant vicinity)	322.0	9/IR-9	22	7.4	8.0	17	20.7	0.24	180	370
	320.6	10/IR-10	21	7.5	7.4	40	48.6	0.52	190	860
Calumet Sag Channel	316.0	11/IR-11	21	7.4	5.8	6.7	8.1	0.09	210	670
	305.0	12/IR-12	22	7.6	8.0	15	18.2	0.33	240	660

Table C-1 continued. Water chemistry data - solid phase sediment and water 96-hour fathead minnow bioassays of sediments collected from the Illinois River in 1989.

Sample Location	River Mile(s)	Sample Number	Temp (deg.C°)	pH	DO	NH_3-N (mg/L)	Total NH_3 (mg/L)	Unionized NH_3 (mg/L)	Total Hardness (mg/L $CaCO_3$)	Specific Conductance (mmhos)
Chicago Sanitary and Ship Canal										
	317.2	13/IR-13	24	7.2	5.6	15	18.2	0.15	220	610
	313.2	14/IR-14	23	8.2	3.5	77	93.6	6.8	180	600
	305.0	15/IR-15	21	7.4	7.3	17	20.7	0.22	175	645
	293.2	16/IR-16	22	7.4	8.1	20	24.3	0.28	180	620
Kankakee River										
		17/IR-17	21	7.4	7.5	6.8	8.3	0.09	255	610
		18/IR-18-1	24	7.8	4.7	2.4	2.9	0.09	180	280
		18/IR-18-2	24	7.7	5.1	5.5	6.7	0.10	220	340
Des Plaines River										
		19	22	7.6	7.7	4.3	5.2	0.09	200	500
		20/IR-20	22	7.5	7.3	3.6	4.4	0.06	185	540
	286.0	21/IR-21	24	7.8	7.7	30	36.5	1.18	130	660
Fox River										
		22/IR-22	24	7.5	7.8	19.0	23.1	0.38	210	680
		23/IR-23	22	7.6	7.7	7.6	9.2	0.17	230	450
Illinois River/ Treats Island										
	279.8	24/IR-24	24	7.8	7.5	12	14.6	0.47	140	560
Illinois River/ Channahon										
	278.0	25/IR-25	22	7.4	7.7	12	14.6	0.17	215	540
		25/IR-25	22	7.4	7.4	13	15.8	0.18	205	610
Peoria Lake										
	175.0	26/IR-33								
	176.0	27/IR-26	23	7.8	7.9	4.9	6.0	0.18	235	570
Illinois River/ Mapleton										
		28/IR-27	22	7.9	8.0	4.4	5.4	0.19	200	450
Illinois River/ Kingston Mines										
	152.5	29/IR-28	23	7.8	7.9	6.0	7.3	0.22	187	470

Table C-1 continued. Water chemistry data - solid phase sediment and water 96-hour fathead minnow bioassays of sediments collected from the Illinois River in 1989.

Sample Location	River Mile(s)	Sample Number	Temp (deg.C°)	pH	DO	NH_3-N (mg/L)	Total NH_3 (mg/L)	Unionized NH_3 (mg/L)	Total Hardness (mg/L $CaCO_3$)	Specific Conductance (mmhos)
Chautauqua NWR										
	127-122	30/IR-29	22	7.8	7.8	3.1	3.8	0.11	200	380
		30/IR-29	22	7.8	7.7	2.9	3.5	0.10	220	360
		31/EMP-29	22	7.7	7.6	2.2	2.7	0.06	200	380
		32/IR-30	21	7.6	7.4	1.0	1.2	0.01	225	390
Mark Twain NWR Brussels District Swan Lake										
	12-5	33/IR-31A	23	7.8	7.9	3.3	4.0	0.12	170	430
		33/IR-31A	23	7.8	7.9	2.8	3.4	0.10	165	380
		34/IR-31B	23	8.0	7.7	0.9	1.1	0.05	190	460
		35/IR-32	23	7.9	7.9	0.1	0.12	<0.01	253	230
		36/IR-34	23	7.9	7.9	0.2	0.24	<0.01	200	400